Threshold calibration of the n-XYTER readout ASIC *

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The n-XYTER 1.0 front-end readout-chip [1] has been widely used in various projects at GSI, including the CBM experiment, the GEM-TPC and others. The calibration of its threshold scale has however never been reported.

A threshold calibration was performed on two n-XYTER chips, operated on Front-End Board rev. D. Since in most applications the n-XYTER is used without prior threshold trimming, the threshold was not trimmed before calibration in this case either (all trim registers were set to 16). The `Vbfb` register was set to 50, `VBiasS` adjusted such that the baselines are at around 2000 ADC units, and all other settings were kept at the `roclib` (rev. 4174) default values.

To determine the absolute value of the thresholds, pulses of the n-XYTER internal test pulser were injected in groups of 32 channels simultaneously. The number of the channels which the pulses were simultaneously injected to appeared to have no effect on the thresholds. A scan over pulse amplitudes (controlled through the `cal` register) was performed (Fig. 1). The threshold was considered to be equal to the pulse amplitude whenever the pulse detection efficiency was 50%. The corresponding amplitude, expressed in units of `cal`, was determined by fitting the scan data with an error function. Then a the calibration of the `cal` register gain was performed individually for each channel, at low thresholds: the pulse amplitude was measured in the n-XYTER slow lane, digitized with the on-board ADC and converted to the physical units using the calibration [2].

In Fig. 2 an example of the obtained threshold distributions for all channels of one chip, at three different `vth` register settings are shown. The mean thresholds as a function of `vth` for the two different chips are shown in Fig. 3 (the error bars are the variances). It can be seen that both the channel-to-channel as well as the chip-to-chip threshold variations are large (if no threshold trimming is done). In applications, where precise threshold setting is necessary, it is therefore recommended to perform the threshold trimming first, and then to redo the threshold calibration. The developed algorithms can be reused. For rough estimates the Fig. 3 can be used.

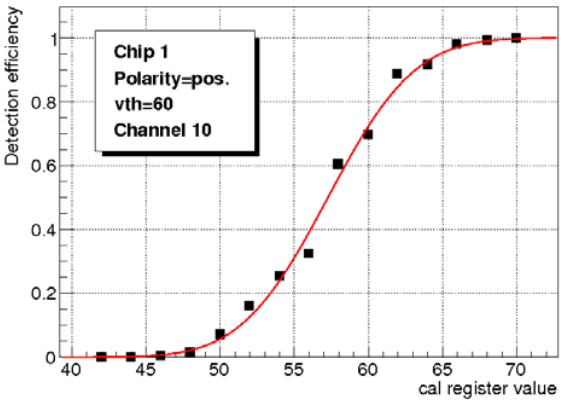

Figure 1: Example for the dependence of the detection efficiency vs. `cal` register setting.

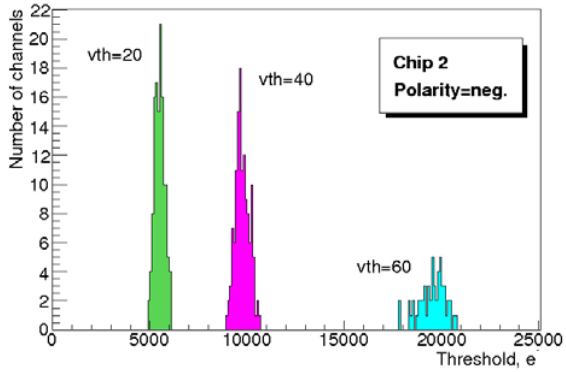

Figure 2: Example of the distributions of the thresholds of all channels in one chip at various `vth` settings.

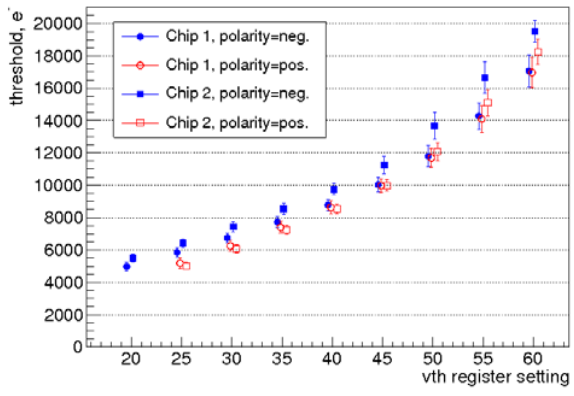

Figure 3: Threshold calibration plot. Points are shifted by $\pm$ 0.15, and $\pm$ 0.45 in x to improve visibility (initially they were at multiples of 5).

References

[1] A.S. Brogna et al., n-XYTER reference manual, unpublished. http://hipex.phys.pusan.ac.kr/drupal/sites/default/files/nXYTER.pdf

[2] I. Sorokin et al., Nucl. Instr. Meth. A 714 136-140 (2013). DOI:10.1016/j.nima.2013.02.013

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